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Rubber Research Institute of Ceylon

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NOTICES

DARTONFIELD GROUP—VISITORS' DAY

Those who wish to visit the Institute are requested to do so after making an appointment. No special days are set apart as Visitors' Days and the services of the technical officers can be availed of for discussion or demonstration only by prior appointment.

PUBLICATIONS

Rubber Research Institute publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates in Ceylon over 10 acres in extent. Forms of application can be supplied to the Superintendents of large estates for the use of their assistants.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Circulars may be obtained on application at -/30 cts. per copy. Future issues in the series will be sent free of charge to estates registered for the receipt of our publications:—

No. 1	Notes on Budgrafting Procedure (Revised May, 1952).
No. 5	Straining box for latex (January, 1940).
No. 6	Notes on the care of Budded Trees of Clone Tjirandji 1 with special reference to Wind Damage (September, 1938).
No. 12	Warm Air Drying House for Crepe Rubber (Reprinted, 1952).
No. 19	Density of Planting and Thinning out (December, 1942).
No. 21	The Control of Bark Rot and Canker (Revised 1952).
No. 32	Crown Budding for Oidium Resistance (Revised October, 1954).
No. 33	Mechanical Felling of Rubber Trees (Reprinted March, 1955).
No. 35	Notes on Rubber Seedling Nurseries (Superseding Circular No. 3) (February, 1952).
No. 36	Contour Lining, Holing and Filling, Cutting of Platforms, Trenches and Drains (Superseding Circular No. 4) (February, 1953).
No. 37	Manuring of Rubber (Superseding Circular No. 30) (March, 1953).
No. 37A	Manuring—Magnesium Deficiencies (Supplement to Advisory Circular No. 37) (July, 1954).
No. 37B	Potassium Deficiencies (Supplement to Advisory Circular No. 37) (September, 1954).
No. 38	Planting and After Care of Budded Stumps and Stumped Budgrafts (Superseding Circular No. 8) (March, 1953).
No. 39	Clonal Seed as Planting Material (Superseding Circulars No. 26 & 27) (July, 1953).

No. 40 Tapping of Hevea Rubber (Superseding Circulars No. 17 & 34) (June, 1954).
No. 41 Pink Disease (June, 1954).
No. 42 Sale of Budwood (June, 1954).
No. 43 Oidium Leaf Disease (Superseding Circulars No. 22 & 28) (June, 1954).
No. 44 Diplodia Dieback and Collar Rot of Hevea & Blue Spot of Crepe Rubber (June, 1954).
No. 45 Phytophthora Leaf Disease and Stem Disease of Hevea (October, 1954).
No. 46 White Root Disease of Hevea (October, 1954).
No. 47 Ustulina Rot of Rubber Trees (November, 1954).
No. 48 Brown Root Disease of Hevea caused by Fomes Lamaensis (October, 1954).
No. 49 Root Disease in Replanted Areas (Superseding Circular No. 31) (October, 1954).
No. 50 Orange Gall of Hevea (December, 1954).
No. 51 Bird's Eye Leaf Spot of Hevea (December, 1954).
No. 52 A Guide to the Cost of Replanting Rubber (December, 1954)
N0. 53 Prevention of Coagulation in the Field (March, 1955).

CLONE PB. 86

BY

D. H. Constable

The writer would like to commence by thanking all those Superintendents who took the trouble to reply to our recent circular requesting information on PB. 86 yields.

The first point of interest arising from the data collected is that PB. 86 has shown itself capable of yields ranging from 1,500-2,000 lbs. per acre on commercial scale plantings in Ceylon. Further that this yield has been attained in all districts and under all climates and soil conditions. A list of the estates falling in this category is given in Table I.

Unfortunately however the overall picture is far from rosy as will be seen from tables 2, 3, 4 & 5 the latter of which summarises the information of the first four tables.

From this we see that the high yielding areas are only 13 per cent. of the whole and yield only 18 per cent. of the rubber derived from replanted PB. 86. Replantings giving less than 1,000 lbs. per acre and averaging 820 lbs., between them cover 452 acres or 36 per cent. of the total area while best yields of 1,000-1,250 lbs. per acre cover a further 318 acres or 25 per cent. of the total area.

The overall average is 1,135 lbs. per acre and it must be noted that this is the average of the best yields ever recorded on estates. A true yearly average would probably be nearer to 1,050 lbs. per acre. At a later stage in this article the economic aspects of such a low average in relation to present day replanting costs and profit levels will be discussed.

When we consider the relationships of yield levels to Districts ((*b*) & (*c*) of Table 5) some very interesting facts come to light. We then see that 80 per cent. of Ratnapura district lie in the lower half of yield levels with 57 per cent. below 1,000 lbs. per acre. Kalutara has just over half its area in better yielding PB. 86 while the Kelani Valley has practically 60 per cent. better yielding replantings.

The remaining three districts have not enough reported data to be reliable but it would appear that neither Kegalle, Kandy or Kurunegala are very satisfactory as high yielding districts though their potential is proved by the 1,700 lbs. per acre on Kepitigalla Group. The area Elpitiya-Udugama-Galle is also clearly capable of high yields though its overall average is poor.

Undoubtedly the last World War is partially responsible for the poor showing due to one or more of the following causes:—

(1) Superintendents away on service.
(2) Lack of manures and diversion of rubber manures to other crops.
(3) Growing food crops in young clearings.

(4) Too early tapping due to the rubber shortage following the fall of the Far East.

However this presumably cannot account for the high preponderance of low yields in Ratnapura. There is one outstanding fact about this district and that is the apparent lack of potash. In this connection as we have previously reported one estate in this area has been lifted from below 1,000 to the 1,500-2,000 lbs. class, in the course of three years, by heavy potash manuring. This is not to say that the whole district may be resuscitated by these means. Some of the plantings are of such poor growth that they lack the yield potential even if the deficiencies are righted and will probably need a 'body-building' course before they will yield well. Whether this latter can be done at an economic figure for the improvement obtained remains to be seen. Regardless however of whether the trouble is manurial or not, the figures presented emphasise the care that must be taken with Rubber replantings in Ratnapura District.

Now whatever the causes may be, this overall picture cannot but cause some apprehension in regard to the present day replanting programme and particularly about its economics.

Rupees 2,000 can for the purpose of example be conveniently taken as the replanting cost per acre. Any replanting estimate depends on getting into tapping at the correct time and a charge of the order of Rs. 120/- per acre must therefore be added for every year lost due to undersize trees delaying the beginning of tapping.

This capital outlay must be recovered from the subsequent profits, or a similar sum set aside for future replanting. In other words the actual planting (though not necessarily the land) is subject to the principles of depreciation in just the same manner as any other piece of manufacturing equipment (which is what rubber trees are).

Next we come to the vexed question of profits about which the IBCON survey may give far more authoritative data than has hitherto been available. There seem to be certain relevant considerations however which suggest that, as far as the grower is concerned, the speculative nature of rubber is passing away and that boom profits of the order of 1951/52 will be much less likely in future.

The first of these considerations is that siphoning off an appreciable portion of such profits by Government is now firmly established. Secondly rising wages are becoming an almost inevitable concomitant of rising prices with much less tendency to drop with price recessions. Thirdly it appears that the supply of synthetic will be used to stabilise the rubber market as far as long term rises in price are concerned. In general, costs of production appear to range from 65 to 95 cents per pound giving an average profit of 20 cents. per lb. This figure has been agreed as reasonable by several members of the industry as covering recent years apart from the Korean boom period. Accepting therefore for the sake of argument a figure of 20 cents per lb. profit and Rs. 2,000 capital to be recovered we have therefore 10,000 lbs. of rubber on which the profit is illusory. The following adverse points then have to be considered in estimating the value of a new clearing.

(1) It normally takes at least six years to come to tapping girth.

(2) It takes 4 more years to attain maximum yields which is equivalent to a further two blank years.

(3) 10,000 lbs. of rubber (per acre) has to be made before the clearing shows a profit (Strictly speaking the 10,000 lbs. should be a yearly pro rata charge over the whole tapping life of the clearing but as this is unknown the writer prefers the simpler method). At 1,000 lbs. per acre this represents 10 years production.

Further of course, in the event of these low maximum yields both (1) and (2) are generally much longer and in some cases investigated (1) has been 10-12 years.

Present day estimates of the life of a budded clearing vary, some schools of thought maintaining that second renewal bark is hopeless but more generally 30 years total appears to be the present estimate. The R.R.I. do not have any records of budded clearings over 28 years at which stage satisfactory yields are still being obtained. With the use of 'ladder' tapping no doubt considerable prolongation of clearing life is possible but at an appreciable increase in tapping costs.

The overall picture is therefore that with effective cultivation leading to high yields, over half the life of a clearing should be profitable. On the other hand ineffective cultivation leads to a vicious spiral of longer immature periods, lower yields, higher c.o.p. and poor bark renewal all of which by giving smaller profits lead to economies in the cultivation thus greasing the downward path.

The planter and the companies may well ask 'What are the proper and necessary methods of cultivation then'? To which our only answer can be proper attention to all aspects of plantation work. These might be listed as:—

(1) Proper clearing of the field with effective eradication of root disease.

(2) Preparation of the planting hole.

(3) The use of good planting material. In this connection it is highly desirable to discard all nursery stocks which do not reach buddable size within two years and bud only onto the most vigorous growers. All nursery stocks should consist of high quality clonal seedlings. Secondly reject even those of buddable size if budding fails more than three times, as those stocks are probably incompatible with the bud material. Further do not keep the rejected stock material for a further year or years. If it takes 2-3 times as long to attain 1 year old size it is likely to do the same to attain any age/size. Such runts should all be destroyed unless a plantation of budded runts is to be obtained.

(4) Use adequate quantities of a manure mixture which either has been *proved* for *your* area (by bringing in other clearings at a satisfactory rate) or follow the R.R.I. recommendations when you have no such alternative proof. Also deal with deficiencies promptly and preferably before they arise to set back your plantings.

(5) Maintain a good ground cover but do not allow it to compete, particularly for applied manures.

(6) Let your trees attain a proper girth and in sufficient proportions in the stand before tapping them. Cutting down girth requirements or tappable percentages can only lead to over early tapping. Remember that a tree girths $3\frac{1}{2}$ inches per year before tapping but only 1 inch. afterwards.

(7) Do not overtap trees under 21″ in girth. Ample evidence is accruing that over 67 per cent. intensity tapping in these small trees *i.e.* trees 18-21″ girth leads to high Brown Bast incidence with obviously a proportional drop in yield. Three years is probably the minimum period for the S/2, d/3, 67 per cent. system to run if tapping commences at a girth of 18″.

(8) Adequately control Oidium after wintering begins.

(9) Apply proper fungicidal protection to the tapping panels.

All the above mentioned points add up to one fact namely that no clearings should be undertaken without the finance available to carry them through satisfactorily and it should be a matter of urgency that no immature clearing be subjected to false economy measures.

We have, at various times been told 'but we cannot afford to manure our clearings' or 'we shall just have to accept a loss of a year or two in starting tapping'.

The fact of the matter is that you cannot afford *not* to carry out full cultivation. The resulting loss is not one of time but of girth and consequently of yield and the figures we have collected suggest that this loss is permanent *i.e.* a clearing that is 20 per cent. behind in time is 20 per cent. down on girth and on maximum yield.

Summing up, there can be no question that in PB. 86 and the newer and higher yielding clones which are beginning to come along, Ceylon has the material for an efficient and economical Rubber Plantation Industry. Whether she will have it in fact depends largely on those in charge of policy and whether the industry is run according to the principles accepted as essential to ordinary business and particularly manufacturing. It is perhaps a pity that in plantation agriculture the effects of an unsatisfactory policy though drastic are comparatively slow in appearance. Therefore the principle 'we must economise, cut down your cultivation and manuring' is accepted as sound commonsense for rubber whereas the man in industry who said 'we must economise, stop oiling your motors and machines' would be sent home for a nice long rest. Yet there is no difference in fact or in principle but only in the period elapsing before the results are apparent.

It should also be remembered that the total profit from 10 acres giving 1,500 lbs. per acre is likely to be greater than that from 20 acres giving 1,000 lbs. per acre while the total capital outlay of the former will be appreciably less than half the latter.

The figures presented in this paper through the courtesy of estates do appear to support the Institute's contention that the minimum of risk should be taken by the Industry particularly in respect of their young clearings. It is once again emphasised that errors made in the early cultivation of these clearings will be with us for the lifetime of most of those now in the Industry and we have little knowledge at present that will permit us to rectify the effects of such errors.

TABLE 1

PB. 86 Yields of Over 1,500 lbs. Per Acre

Estate	District	Year of Planting	Acreage	Actual best yield per acre	Year of best yield
Hunuwella	Opanaike	1938	10 acres	1,534	1953
Opata	Kahawatte	1940	12 acres	1,527	1954
Wellandura	Kahawatta	1940	4 acres	1,613	1954
Galatura	Kiriella	1939	25 acres	1,583	1954
Mapalagama	Talgaswella	1938	1 acre	2,220	1951
		1941	1 acre	1,581	1953
Igalkande	Elpitiya	1940	7 acres	Over 1,500	1954
Dalkeith	Latpandura	1937	9 acres	1,930	1952
Wagga & Halpe	Lower K.V.	1937	1 acre	1,555	1954
		1941	6 acres	1,690	1954
		Same	clearing	1,718	1952
Elston	Puwakpitiya	1938	8 acres	1,604	1952
	,,	1940	19 acres	1,592	1952
Eheliyagoda	K.V.	1939	20 acres	Over 1,500	1954
Kiriporuwa	K.V.	1940	9 acres	Over 1,500	1954
Kepitigalla	Ankumbura	1938	7 acres	1,702	1952
Stokesland	Udugama	1938	23 acres	Over 1,500	1954

Those estates described as over 1,500 lbs. had collected at least 1,400 lbs. per acre in the first 11 months of the 1954-55 tapping year.

TABLE 2

PB. 86 Yields of 1,250—1,500 lbs. Per Acre

Estate	District	Yield of planting	Acreage	Actual best yield per acre
1	Kalutara	1938	12 acres	1,440
1	,,	1939	12 acres	1,408
2	,,	1941	30 acres	1,385
3	,,	1937	10 acres	1,434
	,,	1939	11 acres	1,330
4	,,	1941	5 acres	over 1,300
4A	,,	1941	32 acres	1,449
5	K. V.	1941	4 acres	over 1,250
6	,,	1940	17 acres	1,361
7	,,	1940	18 acres	1,450
8	,,	1939	32 acres	1,345
9	,,	1940	11 acres	1,260
10	,,	1941	5 acres	1,423
11	,,	1938	9 acres	1,344
12	,,	1940	14 acres	1,425
13	,,	1938	18 acres	1,374
13	,,	1939	20 acres	1,250
14	,,	1940	11 acres	1,250
15	Ratnapura	1937	20 acres	1,326
16	,,	1939	13 acres	1,373
17	Passara	1939	18 acres	1,375

TABLE 3

PB. 86 Yields of 1,000—1,250 lbs. Per Acre

Estate	District	Year of planting	Acreage	Actual best yield per acre
18	Kandy	1941	22	1,166
19	K. V.	1940	44	1,050
20	,,	1940	13	1,059
21	,,	1931	18	1,191
21	,,	1940	16	1,070
21	,,	1942	14	1,020
22	Ratnapura	1940	17	1,018
23	,,	1940	4	1,200
24	,,	1938	17	1,191
24	,,	1941	10	1,232
25	,,	1940	8	1,167
26	,,	1940	38	1,097
27	Kegalle	1941	15	1,032
28	,,	1940	—	1,011
29	,,	1940	10	1,240
29	,,	1940	12	1,204
30	Matale	1940	16	1,105
31	Elpitiya	1939	30	1,206
32	Kalutara	1941	11	1,110
33	,,	1942	3	1,118

TABLE 4

PB. 86 Yields under 1,000 lbs. Per Acre

Estate	District	Year of planting	Acreage	Actual best yield
34	K. V.	1940	20	346
35	,,	1947	7	497
36	,,	1941	15	848
37	,,	1942	8	860
38	Ratnapura	1940	33	664
39	,,	1939	24	927
40	,,	1940	25	971
41	,,	1936	5	734
42	,,	1939	30	707
43	,,	1941	13	870
44	,,	1941	66	842
45	,,	1940	30	965
46	Kalutara	1939	5	900
47	,,	1940	47	886
48	,,	1942	42	972
49	Rakwana	1938	10	975
50	Elpitiya	1940	8	972
51	,,	1940	25	896
52	Kurunegala	1940	8	607
53	,,	1942	14	712
54	,,	1943	7	685
55	Kegalle	1943	10	576

TABLE 5

(*a*)—Summaries of Tables 1–4

Yield Class	Total Acreage	%age Acreage	Total yield	% Yield
Over 1,500 ...	162 acres	13%	256,219	18%
1,250—1,500 ...	322 acres	26%	440,785	31%
1,000—1,250 ...	318 acres	25%	355,904	25%
Under 1,000 ...	452 acres	36%	371,417	26%
	1,254		1,424,325	

Average Yield 1,424,325/1,254=1,135 lbs. per acre.

(*b*)—Acreages in each district in each yield class

Yield Class	Kalutara District	K.V. Dist.	Ratnapura	Kegalle	Elpitiya	Kurunegala and Kandy
Over 1,500 ...	9 Ac.	63 Ac.	51 Ac.	—	32 Ac.	7 Ac.
1,250—1,500	112 ,,	159 ,,	33 ,,	—	—	—
1,000—1,250	14 ,,	105 ,,	94 ,,	37 Ac.	30 Ac.	38 Ac.
Under 1,000	94 ,,	50 ,,	236 ,,	10 ,,	33 ,,	29 ,,
	229 Ac.	377 Ac.	414 Ac.	47 Ac.	95 Ac.	74 Ac.

(*c*)—Percentage of acreage in each district in each yield class

Yield Class	Kalutara	K. V.	Ratnapura
Over 1,500 ...	3.9%	16.7%	12.2%
1,250—1,500 ...	48.9	42.2	8.0
1,000—1,250 ...	6.2	27.8	22.8
Under 1,000 ...	41.0	13.3	57.0

PREVENTION OF COAGULATION IN THE FIELD

BY

E. J. Risdon

1. **Introduction.**—Latex from young trees and from the trees of certain clones, *e.g.* TJ. 1, AV. 49, throughout much of their useful life shows a marked tendency to partial or complete coagulation prior to arrival at the factory. This tendency is often particularly noticeable immediately after resting for wintering and in wet weather. Much of the literature dealing with the causes of the natural coagulation of latex is summarised in R.R.I.C. Quarterly Circular 1954 30-2, p. 37. In general, the harmful effects of this tendency to coagulation are minimised by the addition of certain chemicals usually referred to as latex anticoagulants, and by grooming the trees once or twice a year by lightly scraping off all lichens and moss. The latter aspect of the subject together with the possible advantage of 'hedge' and 'avenue' planting in this connection are mentioned by the Botanist in R.R.I.C. Quarterly Circular 1953 29, 3-4, p. 150.

2. **Choice of Anticoagulants.**—At present the preferred anticoagulants are sodium sulphite (not bisulphite), ammonia, formaldehyde (formalin), formaldehyde and sodium carbonate or sodium carbonate alone. Washing soda and soda ash might perhaps be regarded as 'substitutes' for sodium carbonate. For reasons discussed elsewhere (R.R.I.C. Quarterly Circular 1954 30-2, p. 37-38), hard and fast rules concerning the choice of the anticoagulant and more particularly the proportion of the anticoagulant to be used are not offered by the R.R.I.C. as these factors are not independent of the individual conditions involved. In general, however, crepe Estates in Ceylon seem to find sodium sulphite or washing soda suitable, while R.S.S. Estates frequently employ ammonia or sometimes sodium sulphite, and, where an Estate has no a priori reason for using an alternative anticoagulant, it is probably best to start small scale trials on this basis. The information on this subject together with procedures for the preparation of suitable stock solution have been summarised in Table 1 of the above mentioned paper and this table is reproduced below with only minor amendments as an appendix. The 'standard' figures columns in this table may perhaps be rather loosely regarded either as the figures tentatively suggested by the various R.R.Is as initial trial values or as average figures, but they should not be treated as definite recommendations suitable for all conditions. Where the tendency to coagulation in the field or in the transport vehicle is particularly marked, the proportion of anticoagulant required may exceed the 'standard' figure of the appendix and this has actually been found to be necessary in many cases, vide range encountered columns of the table. Excessive proportions of anticoagulant should not be employed, however, as apart from the expense of the extra anticoagulant, there may be difficulties in taking the fraction and the consumption of acid will usually be increased etc.

Attention is drawn to the facts that stock solutions of sodium sulphite are not stable indefinitely and should preferably be made up daily immediately prior to use. Similarly concentrated (*e.g.* 10 per cent. etc.) solutions of ammonia can readily lose ammonia gas on storage.

3. **Method of Application and Procedure.**—A limited number of small scale tests are usually desirable prior to the large scale use of latex anticoagulants. The object of these well supervised preliminary trials is to ascertain whether the anticoagulant chosen is suitable, what is the optimum proportion of the anticoagulant and to obtain some information concerning how much anticoagulant should be employed at the various stages (*a*) on the cut (*b*) in the cup (*c*) in the bucket and (*d*) at the collection centre, as well as to train the Estate's Staff and some of the tappers in the procedures involved. The type of anticoagulant and the concentration to be employed in the preliminary trials can usually be decided by reference to the preceding section and to the table in the appendix, bearing in mind that where the tendency to coagulation is very marked, such as with bad clones or in bad weather, the quantities necessary may exceed the 'standard' figure in the table. The point of addition of the anticoagulant is discussed in the paper mentioned in the preceding section and under normal conditions it can safely be assumed that early addition of the anticoagulant, *i.e.* in the cups with or without addition at the panel, is advisable and probably essential. (Addition of a small portion of the solution to the latex issuing from the top left hand corner of the normal cut is generally followed in Ceylon but it is not certain whether this is invariably necessary. It is probably not desirable to add the anticoagulant well above the cut so that it runs down the previously tapped bark. Limited cases of alleged slight damage to trees due to adding anticoagulant to the panel are reported in the literature but it is not always clear whether this damage is actually due to the anticoagulant and if so whether the concentration of the stock solutions was not unduly high). The tapper has, therefore, to be trained to portion out his anticoagulant solution evenly between the trees or, where it is practicable, on the basis of the anticipated yield of the individual trees. Failure to do this with reasonable care is likely to be one of the major causes of continued difficulty especially if the quantity of anticoagulant used is not excessively large. This implies that it is not generally sufficient to let the tapper 'slip' most of the anticoagulant into the bucket and use the remainder on a few readily accessible trees. Each tapper is usually issued with a glass bottle of suitable size containing the anticoagulant. This bottle may be provided with a short bamboo tube in the neck together with a rubber collar or strip of cloth which can be dipped in latex. The bamboo tube and accessories act as a stopper or cork and by cutting the tube obliquely that is tapering it to a point it is possible to pour the anticoagulant in small quantities onto the places required. Alternatively, the bottle may be fitted with a slotted cork of soft wood. However, it is not easy for even a conscientious tapper to portion out the solution correctly and it is therefore customary to retain $\frac{1}{3}$ (to $\frac{1}{4}$) of the anticoagulant solution issued to the tapper for addition to the bucket after collection from preferably at least 15 to 20 trees. In certain cases it may be important not to add this balance solution to the empty bucket. When the tapper delivers the latex to a collection centre rather than direct to the factory, it is usually desirable to add extra anticoagulant to the collection tank. The general procedure is partially illustrated by the example in the next paragraph.

Thus, if there is reason to believe that .10 per cent. of washing soda, that is 1 lb. of soda per 1,000 lbs. of latex, is likely to be required in the field together with a further .02 per cent. at the collection centre and that the inturn of each tapper is, say, 4 gallons *i.e.* approximately 40 lbs., then each tapper will need a total of .04 lbs. of washing soda solid (powder) made up as approximately 1 pint of the usual stock solution (1 lb. of washing soda powder in 3 gallons of water). Accordingly 1 pint of the stock solution is issued at the factory or collection centre, as convenient to each tapper in a suitably

corked bottle and he is instructed to clean the cup, remove the scrap from the panel, make the cut, run (if required) a very few drops (usually 0-2) down the cut with the latex and then add a little more (usually 2-4 drops) to the cup before passing to the next tree. The amount of anticoagulant used at each stage will depend, for example, upon the size of the drops and the number of trees as well as upon the total volume of solution issued on the basis of prior calculation and should, of course, be portioned out so that (1) each tree has approximately the same volume of anticoagulant or a portion depending upon its yield and so that (2) $\frac{1}{3}$ (to $\frac{1}{4}$) of the solution is left after all the trees have been tapped. When the latex is collected the balance of the anticoagulant is thrown into the bucket after collection from not less than 15 to 20 trees. A further 1 pint of stock solution is then added with stirring to the collection tank for every 20 gallons of latex received. The figures quoted in this paragraph are intended only as examples not as recommendations in respect of quantities.

When it is necessary to change the concentration of anticoagulant used in the field, *e.g.* according to the clone, the weather, the distance to the factory or collection centre etc., this may be done either by changing the volume of solution issued to the tappers or by altering the strength of the original stock solution. The choice will depend upon the individual circumstances. Thus, if the proportion of anticoagulant used in the wet weather is larger than that used in normal (non-drought) conditions then it is generally easier to alter the strength of the stock solutions rather than to change the volume issued to the tappers. It will be apparent that making up the stock solutions should be under the control of the Conductor, the Rubber Maker or other responsible individual. As far as is known the use of an anticoagulant, when required, is considered part of a tapper's normal duties and is not usually made the subject of a special payment.

APPENDIX

TABLE 1

Anticoagulant.	Approximate Quantities of Anticoagulant (> 0%) Used as a % of the Weight of Latex			
	Cups, Buckets, etc.		Lorry, Collection Centre	
	'Standard' Figure	Range Encountered	'Standard' Figure	Range Encountered
Ammonia ...	.01%	.01—.10%	—	.005%—.01%
Sod. Sulphite ...	.05%	.05—.15%	.05%	—
Formaldehyde ...	.02%	—	—	—
Formaldehyde ...	.02%	.02—.1%	—	—
+	+	+		
Sod. Carbonate or Soda Ash	.02%	.02—.1%	—	—
Washing Soda ...	—	.08—.1%	—	.02%

NOTES ON THE USE OF THESE ANTICOAGULANTS

1. **Ammonia.**—The stock solution is prepared by bubbling 1 lb. of ammonia gas carefully and slowly into 10 gallons of water. The addition of 6½ fluid ounces of this solution to 4 gallons of latex gives a latex which is approximately .01 per cent. to ammonia. Excess ammonia or the use of stale latex containing ammonia can affect the colour of the resulting crepe. Ammonia is considered suitable for R.S.S. or cases of bad precoagulation.

2. **Sodium Sulphite.**—The stock solution is made by dissolving 1 lb. of the anhydrous chemical in 3 gallons of water. The addition of ½ pint (10 fl. oz.) of this solution to every 4 gallons of latex makes the latter approximately .05 per cent. to sodium sulphite. The stock solution should be made fresh daily and the chemical (powder) should be stored in a cool place in an air-tight container. Sodium sulphite may not be effective if the tendency to precoagulation is marked. Excess sodium sulphite is believed to retard the drying of sheet and to leave the surface tacky (or glossy) due to moisture absorption rather than to oxidation.

3. **Formaldehyde.**—Latex containing .02 per cent. formaldehyde is made by adding 3 fluid ounces of the stock solution to every 1 gallon of latex. The stock solution is made by stirring 4 to 5 fluid ounces of commercial formalin into 1 gallon of water. Formalin readily turns acid during storage and should be made alkaline to litmus with soda ash before use. Very old formalin is not invariably suitable. Formaldehyde is not considered as effective in wet weather or with certain clones as ammonia and under these circumstances it may be employed with sodium carbonate or soda ash. Formalin can interfere with the colour of crepe. The soda ash used with formalin can be employed by adding 3 fluid ounces of a 1 per cent. solution (1 lb. to 10 gallons of water) to every gallon of latex. As far as is known, formaldehyde is not often employed as an anticoagulant in Ceylon.

4. **Washing Soda.**—The stock solution is made by dissolving 1 lb. of the powder (not crystals) in 3 gallons of water. The addition of 1 pint of this

solution to every 4 gallons of latex makes the latter approximately .10 per cent. to washing soda. This anticoagulant may be preferred by Small-holders on the grounds of cheapness but there is believed to be a risk of bubble formation *e.g.* in R.S.S. It has been used for crepe.

CONVERSION TABLES

(*a*) Handbook of Physics and Chemistry 21st Edition p. 1,732-1,747.

60 minims	=	fl. drachm (Br.)	=	3.55	grams
8 fl. drachm	=	1 fl. ounce (Br.)	=	28.41	c.c.
20 fl. ounces	=	1 pint	=	568.3	c.c.
4 gills (Br.)	=	1 pint			
20 grains	=	1 scruple	=	1.2959	grams
7,000 grains	=	1 lb. (avoirdupois)	=	453.59	grams

(*b*) R. R. I. M. Card 7*c* (1934).

1 Table spoon	=	ca $\frac{1}{2}$ fl. oz.
1 Dessert spoon	=	ca $\frac{1}{4}$ fl. oz.
1 Tea spoon	=	ca $\frac{1}{8}$ fl. oz.

(*To be issued as Advisory Circular No.* 53).

ROOT DISEASE IN REPLANTED AREAS

BY

H. E. Young

Incidence of Disease:

When replanting of seedling rubber land was undertaken in Ceylon it was recognized that some of the young plants would possibly become affected by root disease contracted from centres of infection present in the original stand. It is now a matter of general experience and observation that, in addition to the occurrence of such cases, root disease may and does occur in areas thought to be free of infection as judged by the history and appearance of the old stand. Examination of the root systems of apparently healthy uprooted old trees in a clearing which is being felled has shown that some of the trees are often infected.

Where root disease occurs in replants every case investigated has shown that the fungus almost invariably must have been present before the old trees were removed, but was apparently not doing sufficient damage to produce visible above ground symptoms of its presence. In an infrequent case the trouble has been transferred to the field from an infected nursery. In some cases some roots on the old trees are found to be dead due to root fungi, with no above ground symptoms. In others the fungus is merely existing on the bark of the roots in a state of subdued parasitism. When such an infected tree is felled and its roots are left in the ground the balance between fungus and host tree is upset and the fungus assumes the ascendency and grows actively along the dying and newly dead roots. If a young live root contacts this infected wood it rapidly becomes infected also, with resultant death of the young plant.

In view of the unpredictability of the extent to which infection will occur in any particular area it is difficult to decide in advance whether the adoption of special precautionary measures when clearing the land will prove economically sound. The suggestion made by the Research Institute at present is that all the larger lateral roots should be removed when land is replanted in localities in which white root disease is known to have caused widespread damage. In any case the stumps of uprooted trees should be examined at uprooting for the presence of infection. When an infected tree is found full eradication measures should be undertaken. In all areas known to be infected the lateral roots should of course be removed and old disease patches thoroughly dug over with a view to the removal of old roots as completely as possible. Special attention should be given to the margins of the patches where the fungus is always most active. The presence of rotting timber on the ground surface is not considered to have any effect on the incidence of root disease except in an already infected patch in which case it may prove a source of food supply for the fungus and enable it to persist and be a danger. Burning of surface logs is otherwise only considered necessary in areas where damage to adjacent coconut estates may be caused by the breeding of coconut beetles in the rotting logs.

Poisoning of old stands:

The practice of poisoning old rubber and leaving it to stand and rot, and replanting between the poisoned trees is becoming a fairly common procedure.

From the point of view of root disease this cannot be other than a dangerous project. The tree poisons used such as sodium arsenite have no effect on any parasitic fungi which may be on the roots of the poisoned trees. If these fungi are present and the tree killed, the fungus can grow vigorously and spread out along the lateral roots where it is bound to come into contact with the new roots of some young plants sooner or later with unfortunate results. Poisoning is carried out on the score of economy but this is liable to prove false and a prelude to excessive disease control expenditure. In any case the uprooting of old rubber mechanically, by such implements as the 'monkey grubber' has proved economical. Present costs at the Rubber Research Institute amount to 42 cents per tree. By this method of uprooting, the large laterals are also pulled out of the ground with the tree and in addition can be inspected for presence of disease and precautions taken where necessary. If no sale can be found for the timber it can be burned or left to rot quite safely on uninfected ground.

A practice of cutting off the old tree and poisoning the stumps to prevent suckering is sometimes resorted to. The argument against this is the same as with ordinary poisoning only this method involves the additional expense of cutting off the tree. One monkey grubber at Rs. 850/- operated by four labourers can on the average completely uproot about twenty six trees per day.

Causative fungi:

There are three main fungi which attack the roots of living rubber trees in Ceylon. In order of importance they are:

Leptoporus (Fomes) lignosus
Fomes lamaensis (Brown root disease).
Poria hypobrunnea.

Detection of Disease:

When the roots of a plant are attacked by a parasitic organism the conducting tissues are killed. The roots are no longer able to act as channels along which water may pass to the stems, branches and leaves, and these are therefore starved of water. The first symptom is a wilting of the leaves accompanied by lack of lustre and slight discolouration. Later the leaves fall, the twigs die back and the whole plant dies. These symptoms are similar whichever fungus is concerned, and it is therefore impossible to identify the disease without inspecting the roots.

When symptoms of this nature are observed in the field the first step is to examine the leaves and stems carefully for any evidence of such trouble as Pink disease, Phytophthora infection or lightning damage. If there is no actual stem disease the trouble is probably in the roots and these must be carefully exposed and examined. The appearance of the above three fungi on the roots is described below under the appropriate headings.

Leptoporus lignosus:

Appearance of Roots: The fungus will be immediately evident as a mycelium consisting of whitish or yellowish or pinkish strands running over the surface of the roots and adhering firmly to the bark. When young the mycelium consists of fine white silky threads, but later these coalesce into coarser discoloured strands which are called 'rhizomorphs' on account of their resemblance to small roots. Certain other wood-rotting fungi of the

class to which Leptoporus belongs, produce similar rhizomorphs and these may be found growing over the surface of rubber roots without causing any disease. It is not always easy to indentify the fungus without examining fructifications but, in general, Leptoporus may be distinguished by the fact that the rhizomorphs adhere closely to the bark and are not easily rubbed off. Moreover, they are never dead white but always discoloured.

The cortex and wood of an infected root are permeated by fine mycelial threads which feed on the cells, thus causing them to break down and the root to rot. The rooted wood is soft and sometimes wet.

Fructification: Fructifications of *Leptoporus lignosus* may be formed wherever an infected root or stump comes to the surface of the ground. The fructification is produced as a bracket growing out horizontally from the diseased wood. When fresh the upper surface is a rich, red brown in colour with a lighter coloured margin, whilst the underside, which consists of a large number of minute pores, is orange in colour. As the bracket becomes older and dried up, the upper surface fades to a pale orange colour, while the lower surface become dark brown. On breaking the frucification in two, the upper layer will show white and fibrous and the lower red-brown.

Fomes lamaensis (Brown Root Disease)

Appearance of Roots: The roots, especially the tap root, are encountered with a mass of sand, earth and small stones to a thickness of three or four millimetres. This mass is cemented to the root by the mycelium of the fungus, which consists of tawny brown threads collected here and there into small sheets or nodules. In the early stages the predominating colour is brown, hence the name Brown Root Disease, but as it grows older the fungus forms a black, brittle, continuous covering. In all stages, however, the disease is distinguished by the encrusting mass of earth and stones which cannot readily be washed away.

If the outer coat is scraped away the cortex of the root is found to be decayed, and usually coloured brown or brown mottled with small white patches. The wood is soft, usually dry, and permeated by fine brown lines.

Fructification: The fructification is rarely formed and need not be described.

Poria hypobrunnea:

Appearance of Roots: The fungus forms stout red strands on the surface of the root, but these will only be seen if the disease is detected at an early stage. Later the strands turn black and form an irregular skin which is whitish internally. Like *Fomes lamaensis* the root is often encrusted with earth and stones, though not to so great an extent. In an advanced stage the diseased wood is soft and friable and permeated with reddish lines.

Fructification: The fructification is sometimes formed at the collar of the young plant. It is a flat plate closely applied to the surface of the root or stem, and at the stage usually found is of a slatemauve colour.

Control Measures:

When a diseased plant is discovered the first step is to disclose the source of infection. This is done by following the roots of the affected plant outwards in

all directions from the planting hole until the guilty stump or root is found. This must then be removed and burned and all timber bearing the typical mycelium, whether old roots or young rubber roots, treated likewise. In this exploratory work it may be found that one or more roots of an adjacent rubber tree have also contracted the disease although the foliage is still quite healthy. Such roots should be amputated in healthy tissue and the cut ends tarred, or if necessary the whole plant removed. For additional security a trench 2 feet deep could be dug around the infected area and kept clear until infection is eliminated. This is essential in the case of white root disease.

Diseased material must be burned on the site and not taken away as firewood or to be burned elsewhere and all soil removed must be put on the site not outside it as it may spread the disease further.

The essence of successful control is to eradicate the fungus completely in the early years of the clearing, and the treatment outlined above, although somewhat expensive, will pay for itself handsomely by preventing the occurrence of the large disease complexes which are unfortunately to be found on many old estates at the present time.

The treated area should be kept clear of creeping cover crops for about two years, but should be planted thickly with *Crotalaria anagyroides*. This plant is also susceptible to attack by root diseases and the presence of any diseased bushes will indicate the existence of a piece of infected wood which was overlooked in the original exploration. The bushes should therefore be inspected from time to time and any dead or sickly plant pulled up for examination of the roots. If these show the typical symptoms of any of the diseases previously described the source of infection must be traced and removed. These Crotalaria plants must only be lopped very lightly or they will die back on account of lopping and lose their value as indicators.

Any vacancy resulting from root disease should be supplied with a budded stump without delay, provided the clearing is not older than two years from the time of budding. Stumped buddings, may be used as supplies for a further year, but thereafter it is uneconomic to supply vacancies unless they occur in a group as the supplies due to competition with the older plants seldom reach tappable girth.

Root Inspection:

In a clearing where root disease is prevalent it is recommended that the above measures be supplemented by periodical examination of the root system of each individual plant, the object being to disclose and remove the sources of infection with the least possible delay and thereby to save young plants which would otherwise be killed. The method is to excavate the bole of each young plant until the tap root is exposed to a depth of about six inches and the upper laterals for a distance of about twelve inches from the stem. The work should be carried out with a pointed wooden tool so as to damage the roots as little as possible. The plants thus examined can be divided into two categories:—

(1) Those on which there is no trace of parasitic mycelium. In such cases the earth is carefully replaced and packed round the roots which have been exposed, and the tree is given a mark to signify 'examined and found healthy'. Although free from disease such trees will have to be re-examined on the next round.

(2) (*a*) Those on which parasitic mycelium is found growing on the exterior of one or more roots and (*b*) those plants of which the tap root or one or more of the exposed lateral roots are found to be actually diseased. These (*b*) plants must be removed and burned and, in fact, treated according to the procedure recommended in earlier paragraphs. In the case of (2)*a* a single affected root may be amputated into healthy wood. The root removed and the cut stub tarred and the infection focus such as an old diseased root or stump eradicated.

Three rounds of inspection should be carried out at intervals of four months, followed by two rounds at intervals of six months, *i.e.* five rounds in all, covering a period of two years. By that time it is hoped that the fungus will have been almost completely eradicated.

It may be noted that there is no object in examining very small plants (later supplies) whose roots have not yet penetrated beyond the planting hole. Unless a piece of infected material were introduced in the filling such plants could not yet have contracted the disease.

In the case of those plants (*a*) in which white root disease is present but no death of tissues has resulted it was for a time the practice to treat the affected root system with copper sulphate solution. This however has been found to be only a temporary palliative as the infection focus is still left and the tree soon becomes infected and eventually succumbs in practically every case. Unless the focus of infection is found early eradication is the least expensive treatment and may save a neighbouring tree or trees whose roots have not yet penetrated the infected zone.

New Plantings:

In the case of new plantings on jungle land it is found that there are usually one or two cases of root disease occurring. This is due to natural presence of the parasites on jungle roots and stumps. Such cases when found should be treated as advised above and the patch demarcated and cleaned.

Length of Survival of Fomes on wood:

In the case of wood decay a series of fungi usually operate one after the other. Some species such as *Leptoporus lignosus* require unrotted wood tissues for their needs, when this tissue is used up other organisms with different requirements take over the material and break it down further and so on, and the earlier organisms disappear. It will thus be seen that *Leptoporus lignosus* is able to survive whilst unrotted wood is present. That is on small roots etc. the infection is liable to disappear quickly, as these rot fast, and on large thick pieces to exist for as long as they take to rot. At the Rubber Research Institute living Leptoporus has been found on old stumps up to five years of age whilst it has disappeared quicker the smaller the piece. This emphasises the necessity for the removal of at least the larger pieces of rubber wood from the soil in infected patches and also the danger which is courted by leaving unexamined rubber stumps in the soil as in the case of poisoning old rubber and interplanting.

MANURING BY SPRAY

BY

D. H. Constable

Questions, both at the R.R.I.C. Conference in 1953 and more recently at a District Planter's Association meeting, have been raised as to the suitability of spraying as a means of manuring rubber trees. Some considerable advantage was claimed for this method of manuring and instances of its successful use were cited.

Although we do not feel that the industry is seriously considering this matter it might be of interest to sum up recent work on the matter and quote some opinions.

We are assisted in this by a recent bibliography published in Soils and Fertilisers (1953 Vol. XVI Pages 246-262) and by an article by Dr. Boynton in the Annual Review of Plant Physiology for 1954. Both these publications can be seen by interested persons at the library of the R.R.I.

Before discussing the subject both in general, and as it applies to rubber, it is as well to consider the crops upon which experiments have been made and their economic aspects.

Work has been done principally on apples, pears and similar tree fruits, sugar cane and pineapples.

Now the fruit and market garden industry is one in which high premiums may be obtained for top quality or off season produce. The earliest new potatoes in England, for example, may fetch 10/- shilling a pound, similarly the difference in price between top grade and ordinary apples can be 100 per cent.

Now it has been found that ripening, appearance, etc. of products can be largely altered by the right amount of nutrient at the right time. Soil applications are always slow and uncertain whereas direct application to the plant ensures almost immediate take up and response, leading say, to a nicely rosy apple just that little earlier to give the premium market. Another example of a different kind is with crops grown for, or valuable because of, their protein content. Protein requires nitrogen, but large amounts of nitrogen cause soft growth, giving 'lodging' in cereals and delaying maturity generally, a very serious consideration with the English summer. So the ideal with such crops is to apply the minimum nitrogen to give good growth of the plant and further quantities when the crop or fruit is developing, so that most of the added nitrogen goes where it is most wanted. This aspect was studied very seriously in Germany during both wars when nitrogen conservation was of the highest importance.

To revert now to our main subject, spraying of nutrient elements is done for two principal reasons: the first that of correcting deficiencies, the second for manurial use. The correction of deficiencies is concerned chiefly with the trace elements Iron, Manganese, Copper, Zinc, Boron and Molybdenum. As the normal quantities of any of these in plant tissue range from 1/100 of

1 per cent. down to 1/10,000 of 1 per cent. the amounts needed to be applied even in the most severe deficiencies are very small. Consequently spraying may be done with quite small scale equipment. Another factor is that applications, of the needed element, to soils are frequently immobilised or 'fixed', and can do no good to the plant. Hence, in such cases, spraying or injection into the plant is virtually the only way of correcting the deficiency.

This brings us to the second reason for spraying and the one with which we are principally concerned. Here we have a rather different problem as tissue concentrations for Nitrogen for example, normally range from 1-5 per cent. equivalent to 5-25 per cent. of sulphate of ammonia. The other elements generally range from 0.2 per cent. up to about 4 per cent. Now the effect of broadcasting fertiliser and particularly Sulphate of Ammonia on foliage is well known to planters. It can easily be seen therefore that spraying with solutions of the concentration needed for direct fertilisation would be fatal, and in fact several sprays of a harmless strength have to be made at intervals, in order to apply sufficient of any nutrient without harmful effects.

Typical results quoted by Boynton for foliage scorching effects are shown in Table I. As a rough rule it might be safe to say that for every pound of fertiliser you will need 50 gallons of water in order to ensure freedom from leaf and tissue damage. Taking the most favourable view however it is possible that rubber might tolerate 1 lb. to 10 gallons (100 lbs.) of water. The harmlessness or otherwise of higher concentrations is generally very dependent on both the weather, and the state, or physiological age, of the leaves.

TABLE I

Crop	Element needed	Form of Element	Concentration	Damage Bad, Mod Light or None	Remarks
Apples	Nitrogen	Nitrate	5 lbs. per 100 galls.	Bad	—
		Amm. Sulphate	8 ,, 100 ,,	Bad	—
		Urea	5 ,, 100 ,,	None	Higher concentrations injurious
		Urea	5 ,, 100 ,,	,,	—
Citrus		Urea	1 ,, 10 ,,	Light	Definite injury at higher concentration
Apples	Potassium	Muriate of Potash	1 ,, 10 ,,	Light	—
Cotton	Nitrogen	Urea	1 ,, 10 ,,	Mod.	—

Again, as concentrations are increased, it will be more desirable to protect the operator from the spray. Although none of the materials used are poisonous, large scale ingestion of concentrated solutions is not to be recommended and when spraying with Magnesium (Epsom salts) may result in a marked disinclination to attend muster the next day.

If we postulate that 1 year old trees require about $\frac{1}{4}$ lb. of fertiliser per tree (if utilised 100 per cent.) then we need $2\frac{1}{2}$ gallons solution per tree or on present day spacings 500 gallons per acre. This can be split into several applications but will still represent volumes of the order of 100 gallons per acre. In the second year the quantities are doubled and in the third year trebled or quadrupled.

Towards the end of the third year too it becomes impossible to spray the foliage with hand operated equipment unless the trees have been pollarded.

Now these volumes of spray involve equipment for storing and mixing the fertiliser solution, moving it out to the field and finally transferring it to the spray equipment without wasting half of it and it must be remembered that the mixing cannot be left in unskilled hands or you may expect to defoliate your clearings by overstrength mixtures which naturally save time and work for the labourer.

Next we may consider the effectiveness of foliar sprays as given by a number of workers.

Fisher working on apples over several years and using 3 sprays each of 5 lbs. Urea per 100 gallons of water found that spraying was perhaps a little more effective than the same amount of Nitrogen in the soil.

Sugar cane spraying by aircraft was found to give a rapid increase in the plant nitrogen and chlorophyll. The early difference between soil application and spray lasted for only four weeks. There is a definite use here for spraying because a fully 'closed in' sugar cane field is practically impossible to penetrate for the purpose of putting down more soil fertiliser at the right time.

In general urea spraying of peaches and grapes have been disappointing or inconclusive.

On Tomatoes and Celery a significant yield increase has been obtained by spraying. Other experiments gave no results with five different field crops.

Boynton concludes that under some circumstances spraying may be relied on as an important source of nitrogen.

For magnesium the prognostications are favourable and cure or prevention of Magnesium deficiencies is more probable by spray than by soil applications.

Phosphorus and Potassium have not had a lot of study but again rapid early increases are followed by a slower but equivalent improvement from equal soil applications.

It is a quoted point of advantage that application to the tree avoids the losses incurred by soil applications. No objection can be made to this with trace elements but with the macro elements it is less certain. Boynton lists three causes of losses 'twixt cup and lip' namely (*a*) Failure of the spray to settle on the leaf, (*b*) Drip' (*c*) Volatilisation.

Taking (*a*) first we have (1) the degree to which the spray equipment limits application (2) the excess of spray emitted over that needed to cover the leaves, (3) the delay before rain or dew washes off the leaves (4) the amount of rain and (5) the degree of stickiness of the deposit. Losses of up to 50 per cent. on apple trees have been demonstrated whereas on a sugar cane field completely closed in, 25 per cent. to less than 10 per cent. was a normal loss.

Heavy rain within 8 hours of an application will wash off 80-90 per cent. of the material on the tops of leaves and 40-60 per cent. of that on the underside. It can be argued that loss from the leaf may be recovered in the soil but the high dilution and spread is not favourable to recovery particularly where either fixation or high rates of leaching exist. Considering the young rubber tree in this light and bearing in mind the separation between trees and the sparseness

of the foliage it will be readily seen that the odds are in favour of the spray not alighting on the leaves rather than otherwise. However on most clearings the spray thus lost is likely to benefit the cover crops so that the spray is not wasted.

On the other hand over 50 per cent. spray lost does not compare favourably with the expected rates of nitrogen or potash recovery from soil applications though it is likely to be appreciably better than the phosphate recovery from soil. However this latter point is offset by the very high price commanded by soluble phosphoric acid as compared with Saphos phosphate which latter is of no use for spray purposes.

Boynton lists three conditions for the feasibility of foliar nutrition by spraying.

(*a*) The existence of special problems for which soil applications do not answer.

(*b*) A satisfactory response to the nutrient spray.

(*c*) Economic materials and methods of application.

Now, how does our problem measure up to these requirements? Firstly we have no special manuring problems, soil applications are satisfactory and we have so far no reason to suspect trace element deficiencies. We are not worried about early ripening of crop or any related type of problem.

Secondly as regards response of the crop we have no information and, except for academic purposes, we are unlikely to study the matter.

On the score of (*c*) we have discussed the items which will cost money and here again we may quote: 'If there were no other reason that the proprietary full nutrient spray materials at present on the market were uneconomic, their cost alone would usually rule them out for commercial operations. Given materials at competitive cost, the cost of application is a matter of primary importance. In general the capital expense of modern spray machinery cannot be borne by a foliar nutrition programme; on the contrary, foliar nutrition of a crop is usually feasible only because spray machinery and a spray programme exist in operation anyway '. . . . It seems unlikely that proprietary mixtures of nutrients for foliar application serve a purpose that is generally useful'.

This then is a summation for crops on which high profits are made and for which, in general, high expenditure on cultivation and plant protection is both normal and economic.

It is obvious then that rubber with its low profit margins, and restricted cultivation and plant protection, is unlikely to be a suitable field for this type of operation.

Should however the day come when spraying against Oidium or Phytophthora is part of the normal estate cultivation then it will be possible, seriously to consider whether foliar nutrition would be of value.

In the writer's opinion if this should come about it is most likely to be exploited on mature trees where the responses to soil applied fertilisers have so far been small and slow. Such sprays might prove a quicker answer to the potash deficiency troubles which are now rife in some areas.

A WART DISEASE OF DESMODIUM OVALIFOLIUM CAUSED BY A SPECIES OF SYNCHYTRIUM

BY

H. L. Munasinghe

A warted appearance and the ultimate death (Fig. 10) of shoots of *Desmodium ovalifolium* (a popular ground cover plant for *Hevea brasiliensis*) was first reported from Kiribatgalla Group (7), Nivitigalla (Ratnapura district), in September, 1952. Since then, several other estates have also reported the presence of this disease. Dalkeith Group, Latpandura (Kalutara District), where several acres of damage has been caused, provided a ready source of material for examination. The first investigation of the disease (7) which was carried out by the Mycologist of the Rubber Research Institute (Ir. J. H. van Emden) showed that the phenomenon was due to attack by an unidentified species of Synchytrium.

The typical symptoms of the disease were reproduced by artificial inoculation of the host in the green house. The disease is becoming fairly widespread in the wetter rubber districts of Ceylon.

SUMMARY OF LITERATURE

The genus Synchytrium was established by de Bary (1831-88) and Woronin (1838-1903). Since its inception Synchytrium has been subject to much controversy.

Fitzpatrick (1930) proposed a key to the sub-genera, which was extended and modified by Karling (1953) (3*a*). Karling's classification is based on the morphological and physiological characteristics of the fungus. The presence or absence of summer sporangial sori and resting sporangia, the type of resting spore germination and the development of the mature vegetative thallus into a sorus or its function as a prosorus, are the main distinctive characters used by Karling. He makes no distinction between sporangia and gametangia or between zoospores and gametes, because they are morphologically and structurally alike, so far as is known at present.

Contrary to Karling's views other investigators such as Cook (1953) (1*a*), consider the shape and structure of the galls produced by Synchytrium, more definite and valuable for description and identification than any characters of the fungus.

According to Karling (1953) (3) and (1954) (3*a*) the type of galls produced is only helpful in distinguishing the species but is not definitely indicative of the type of life cycle and development. He adds that galls bearing prosori or sori may be quite different from those which bear the resting spores. Further Karling states that the morphology of the species of Synchytrium described by Cook (1945-1953) has been neglected, so that it is impossible in some cases to determine whether prosori, sori or resting spores are being described. Karling goes on to add that the majority of new species created by Cook and others, call for reinvestigation.

The majority of work on species of Synchytrium to which the author turned as a possible means of specifying the fungus here described, were indeed lacking in salient factors on which modern classifications are based. An endeavour is made in this paper to describe the Synchytrium on *Desmodium ovalifolium* as completely as possible.

The only species of Synchtrium so far recorded from Ceylon is *Synchytrium fuscum*, Petch (5), on *Emilia sonchifolia*, Galboda, December, 1911. *Synchytrium decipiens* (Peck) Farlow, has been recorded from *Desmodium Desv.*, *Desmodium canescens* and *Amphicarpa monica* in the U.S.A. According to Cook (1946) (1*b*), *Synchytrium decipiens* is the most widely distributed species of Synchytrium in America. Evidence on these and other species however, are insufficient to merge the species here described with them.

SYNCHYTRIUM ON DESMODIUM OVALIFOLIUM

Economic Damage and Conditions favouring Disease:

The extent of economic damage caused by this disease cannot at the moment be considered important.

The disease is confined to humid environments owing to the fact that wet conditions are required for its spread and is it is unimportant in drier areas and even in the wetter areas cannot spread except during the wet periods.

A heavy canopy of foliage on the rubber trees probably encourages the development of attack due to the moist conditions which prevail for a longer period under shade.

The sporangia, under suitable conditions are able to cause infection shortly after their release. The time of survival of resting spores in the soil and their importance in the life history of the fungus in the rubber fields is unknown.

Desmodium ovalifolium is an important cover crop in rubber in Ceylon and is one of the few species which are able to be grown usefully under some shade. No killing out of the entire host plant has yet been observed, the damage so far recorded is confined to attacked shoots. The plants themselves recover between the rainy intervals as the new shoots are not affected at that time. Desmodium ovalifolium also has the added protection in that it is reproduced freely from self sown seed which survives for long periods in the soil.

The Malformations:

The disease first appears as aggregations of minute galls formed by the abnormal displacement of the epidermal tissues of the host plant. The galls are mainly formed just below the growing apex and infection sometimes extends for one or two inches down the stem (Fig. 10). Infection of the petioles and leaf blade (chiefly along the midrib and veins) is of common occurrence.

The normal growth of the shoot becomes arrested and in the area below the terminal bud the stem becomes distorted (Fig. 10). When a shoot is invaded by repeated generations of the fungus, individual galls are hardly distinguishable as the malformation then appears as an uniform swelling of the stem.

The Galls:

A gall in its first stages is light green in colour but in a few days becomes a dull yellow, due to the colour of the contained fungus. From this stage onwards the colour of the galls depends on whether the fungus is developing into summer sporangia (Fig. 5 and 6) or a resting sporangium (Figs. 8 and 9). (The name 'resting sporangium' is henceforth used for the resting spore stage of this species as there is clear evidence to show that the resting spore functions as a sporangium giving rise directly to zoospores).

Galls containing developing summer sporangia retain their dull yellow colour but those forming resting sporangia become at first light brown and later dark brown in colour.

Galls are extremely variable in size and shape. They are generally hemispherical but are often even spheroid with only a very narrow area of tissue connecting the gall to the plant. They measure from 0.1 to 0.5 mm. in diameter. Galls of the larger dimensions being generally those containing two or three thalli.

THE FUNGUS

The Zoospore :

Both summer and resting sporangia at maturity liberate numerous zoospores which are hyaline, spherical and uniflagellate (Fig. 1 and inset). When stained (6) (with a mixture of equal parts of 0.005% crystal violet and 0.002% acid fuchsine in water) many darkly staining granules are seen which form a reticular pattern, within which two or three unstained spots are also visible. A nucleus has not been recognized.

When a sporangium is crushed some of the zoospores which are forced out have a minute spherical body attached to each of them (Fig. 1). This body is either attached to the zoospore directly or is connected to it at the extremity of a short protrusion. This phenomenon is not evident when the zoospores are left in water for sometime and it is believed that this protrusion is an undeveloped flagellum which with time, will narrow and lengthen to form a flagellum. The diameter of the zoospores vary from 1.4 to 6.0 microns and the flagellae from 2.0 to 6.0 microns in length.

The zoospore when it enters the epidermal cells of the host (Figs. 2*a* and *b*) loses its flagellum. It is not possible at this stage of the investigations to make a definite statement regarding the host reaction to this parasite neither can it be provisionally placed in any of the categories listed by Karling (1954) (3*b*), until an exhaustive cytological study is made. However a general study suggests that the galls are an outcome of host cell displacement due to the gradual growth of the parasite, the deformed gall cells lying around the parasite suggest that this is the case.

The Prosorus :

Having established itself within the host the organism develops into a uninuclear thallus enclosed in two membraneous walls, the outer of which is thicker, the whole forms the prosorus (Fig. 3). At this stage of development the organism is independent of its original host call, having grown out of it, and now lies in a cavity surrounded by the displaced and deformed cells of the higher plant.

Summer Sporangia :

The wall of the prosorus extends to form an empty sac-like vesicle into which the contents of the prosorus flow from its double walled thallus (Fig. 4). The organism is now in the sorus stage and cleavage into summer sporangia takes place (Fig. 5). The nucleus divides into a number of daughter nuclei which are later included in the sporangia. Portions of protoplasm of the sorus surround each daughter necleus and a thin wall appears around each of the bodies isolating them from one another. The nucleus of each sporangium in turn divides and numerous zoospores are differentiated.

When summer sporangia are mature and ready for dispersal the gall ruptures and the sporangia lie as a yellow powdery mass in the cavity thus produced (Fig. 7). The summer sporangia are bright yellow in colour.

Among the zoospores within the sporangium oil droplets of a bright yellow tint are to be seen. These are responsible for the colour of the sporangium. The oil droplets are not in evidence at the time of spore dispersal and possibly constitute a source of food for the spores. The sporangia are polygonal (presumably due to the pressure exerted on each other when within the sorus) with a roughly spherical aspect (Figs. 6 and 7). Their diameters range from 16.0 to 25.0 microns. Each sorus produces 40 to 50 summer sporangia.

The Resting Sporangium :

There is no evidence of a sorus stage prior to the formation of a resting sporangium. A thick dark brown wall is formed around the prosorus (Fig. 9). The nucleus divides and subdivides and zoospores are formed in the same way as in the summer sporangia (Fig. 9). Mature resting spores are liberated when the galls breakdown and they remain in a dormant condition until favourable conditions for spore dispersal arise. The length of time of survival of ungerminated resting spores is unknown.

The resting sporangium is roughly oval in shape. The inner chamber containing the zoospores is spherical but in some cases oval. Resting sporangia measure from 64 to 176 microns in length and from 57 to 96 microns in breadth, externally. The inner chamber containing the zoospores varies from 57.6 to 80.0 microns in diameter.

Oil globules, as found in the summer sporangia, are also present. The occurrence of two chambers both enclosed in the same sporangial wall and each containing zoospores is fairly common.

Spore Dispersal :

Summer sporangia picked directly out of the host plant are shrunken but swell when brought into contact with water. When left overnight in water, the sporangia become hyaline and a rapid movement of their contents is to be seen. The zoospores emerge as a cloudy suspension and swim away after some time.

The mode of dispersal of zoospores from the resting sporangia is at present unknown. Resting sporangia with ruptured walls are to be found but whether this is due to natural development or mechanical damage is uncertain. However as the zoospores crushed out of the sporangia are actively motile and capable of producing infection it may be presumed that spore formation takes place internally.

The Possibility of a Sexual Stage :

A sexual union between gametic zoospores has been demonstrated in some species of Synchytrium (2) and (4) (in *S. endobioticum* by Curtis 1921 and in *S. fulgens* by Kusano 1930). The zygote is reported to be biflagellate and it is presumed by some investigators that the resting sporangium is the result of a sexual union ; this however has yet to be proved. In the species here described two zoospores were found in contact (Fig. 1) and stained specimens revealed biflagellate forms. But it is yet uncertain if a true sexual stage exists.

Artificial Inoculation :

Zoospores crushed out of resting sporangia as well as pieces of tissue containing dispersed summer sporangia were able to produce infection in *Desmodium ovalifolium* plants growing in pots. Drops of water containing zoospores were put on very young buds, and pieces of tissue containing liberated summer sporangia were tied on to growing shoots. A very high humidity had to be maintained. The points of inoculation were covered with moist cotton wool kept constantly damp. In 14 to 18 days from inoculation dull yellow galls appeared which gave rise to summer sporangia 8 days later. Approximately 35% of the inoculations carried out proved successful. No resting sporangia were developed in artificial injections.

CONCLUSION :

The species of Synchytrium here described has been dealt with on the lines proposed by Karling (1953) (3) and (1954) (3*b*). The fungus is described as fully as possible but the host range and host reaction are to be studied in detail. No importance has been attached to gall character as suggested by Cook (1953) (1*a*), as in this case it has been extremely variable. The establishment of the organism concerned as a new species, with the name *Synchytrium desmodiae* is proposed. This species belongs to the sub-genus Mesocytrium after Karling's classification (1953) (3). Type specimens will be deposited in the herbarium of the Mycology Department, Rubber Research Institute, Agalawatta, Ceylon.

ACKNOWLEDGEMENTS :

The help of the Director and staff of the Rubber Research Institute in the form of advice and criticism is gratefully acknowledged. The co-operation provided by Mr. C. Bowen and his staff at Dalkeith Estate, Latpandura, is much appreciated.

DIAGNOSIS

Synchytrium desmodiae sp. nov.

Gallae—minutae, hemisphericae, aliquando sphericae, subter crescentem apicem caulis culmorum, utraque pagina foliorum et foliorum petiolis. Primum pallidae viridae, postea lutae si aestate sporangia proferunt, brunnae si sporangia quiescentia proferunt. Plerumque continet unum thallum aliquando autem duo aut tres. 0.1—0.5 mm diam.

Zoospore—liberata ab auto aestativis at quiescentibus sporangis. Sine colore spherica, cum uno flagello, cum tenuibus muris. Zoospore 1.4 u—6.0 u diam., 2.0 u—6.0 u longus.

Prosorus—cum unico nucleo, saeptur duplicitus muris membraneis. Jacet in caverno disiectis cellulis hospitibus lito.

Aestatia sporangia—lutae, cum tenue muro sine colore, cum lutae ileae guttae intus. Polygonis prope sphericase 16.0 u—25.0 u diam.

Quiescentia sporangia—Ovata, cum crassis muris brunna ; lutae olei gutta inter 64.0 u—176.0 u longitudo 57.0 u—96.0 u latitudo.

SYNCHYTRIUM DESMODIAE n. sp.

Incidence—On Desmodium ovalifolium, on rubber estates in Ceylon.

Galls

Minute, hemispherical, sometimes spheroid ; found just below growing apex on stem, on both surfaces of leaves, and petioles ; at first light green, later yellow if forming summer sporangia, brown if forming resting sporangia ; rupture at time of dispersal of sporangia ; generally contains one thallus, sometimes two or three, diameter 0.1 to 0.5 mm.

The Zoospore

Liberated from both summer and resting sporangia ; hyaline ; spherical ; uniflagellate ; thin walled ; 1.4 microns to 6.0 microns diameter. Flagellae 2.0 microns to 6.0 microns in length. Minute spherical body sometimes attached to zoospore. Presumably undeveloped flagellum.

The Prosorus

Uninuclear ; bounded by double membraneous walls, lies in cavity bordered by displaced deformed host cells.

The Summer Sporangia

Yellow, thin hyaline wall ; with bright yellow oil droplets within ; polygonal but roughly spherical ; 16.0 microns to 25.0 microns diameter. 40 to 50 sporangia from a single sorus.

The Resting Sporangium

Oval ; thick walled 6.5 microns to 15.0 microns ; brown ; yellow oil droplets within ; 64.0 microns to 176.0 microns in length and 57.0 microns to 96.0 microns in breadth. Inner chamber containing zoospores spherical 57.6 microns to 80.0 microns diameter.

Specimens for examination were obtained from Dalkeith Group, Latpandura, Ceylon.

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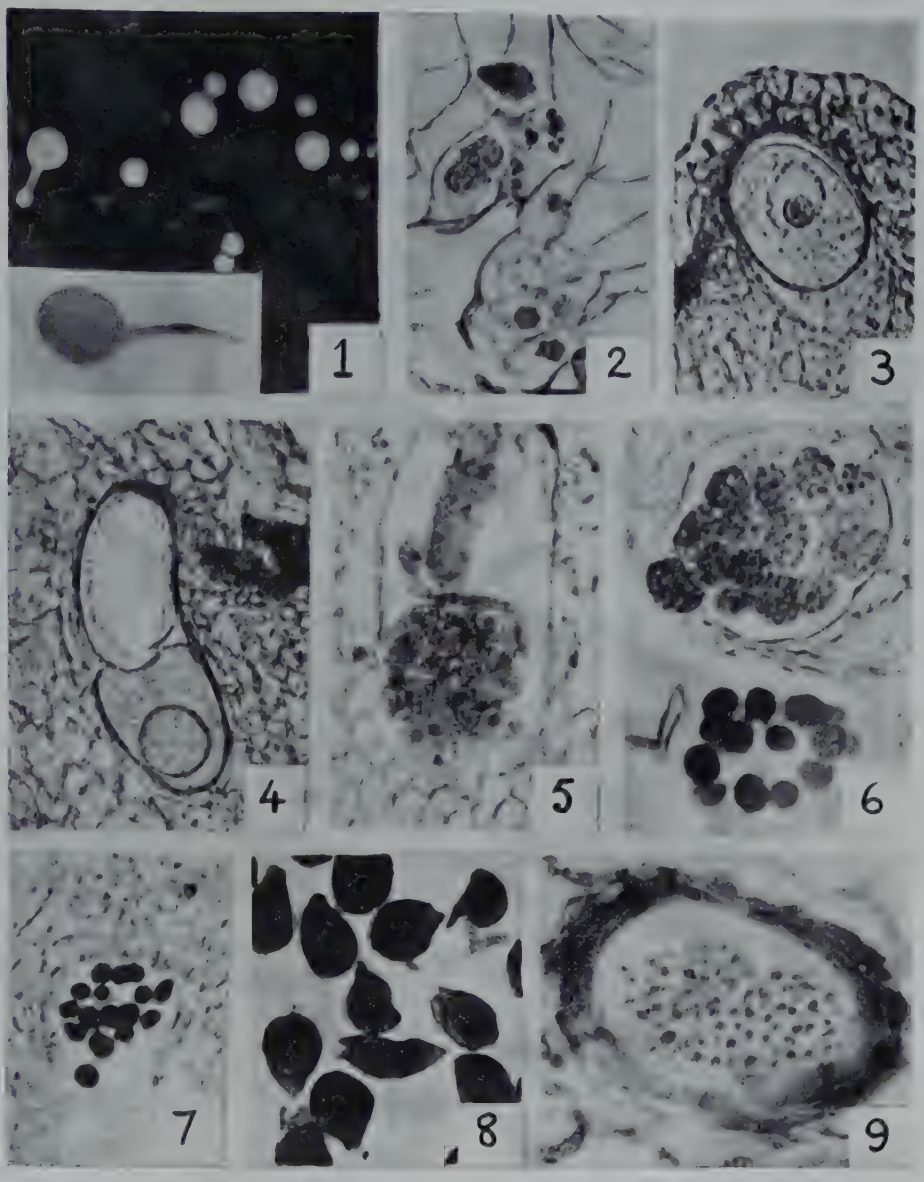
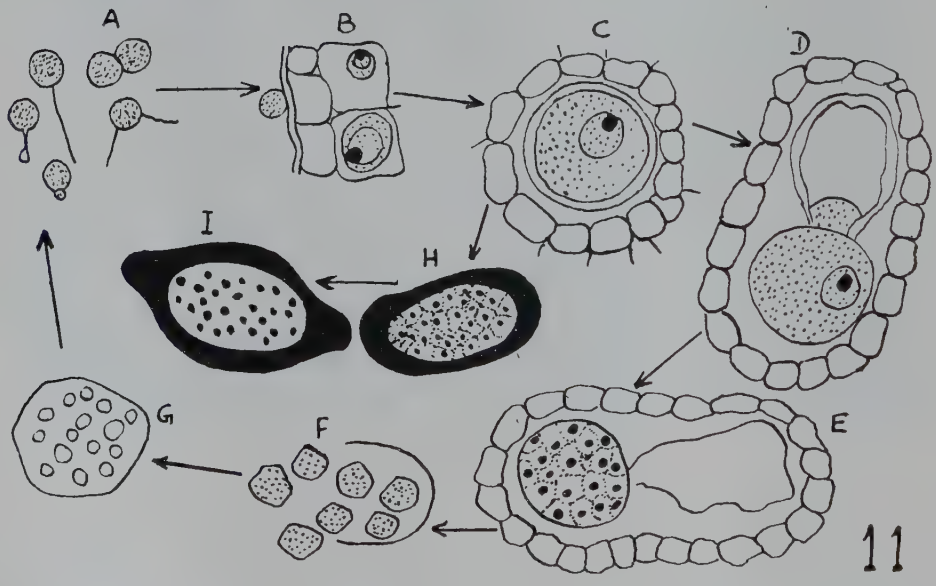


1. Zoospores demonstrated by Burri's negative staining method. 1 (inset). Single zoospore with flagellum. 2. Transverse section of host tissue with zoospores shortly after entry. 3. Transverse section of gall showing the prosorus stage. 4. Formation of the sorus. 5. Uninuclear bodies developing into summer sporangia being differentiated. The abandoned wall of the prosorus is seen above. 6. Summer sporangia showing differentiation into zoospores 7. A group of summer sporangia at dispersal. 8. A group of resting sporangia after dispersal. 9. Longitudinal section through a resting sporangium the zoospores are seen within.



10. The stages of damage to the host plant. A. Healthy shoot. B. The first stages of infection. C. Severe infection. D. Dead shoot.

11. A diagramatic representation of the life-cycle of Synchytrium desmodiae A, B, C, D, E, F, G, represents the summer cycle. A, B, C, H, I, represents the winter cycle.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 133rd meeting of the Rubber Research Board held at the Planters' Association Head Quarters, Colombo, at 2-30 p.m. on Monday, 17th January, 1955.

Present :—Mr. W. P. H. Dias, J.P. (in the Chair), Mr. G. H. Carter, Mr. H. Creighton, Mr. W. Herbert de Silva, Gate-Muhandiram Arthur, D. S. Jayasinghe, Dr. A. W. R. Joachim (Director of Agriculture), Mr. B. Mahadeva (Rubber Controller), Senator C. F. W. Wickramasinghe, Dr. H. E. Young (Director) and Mr. C. D. de Fonseka (Administrative Secretary).

1. **Board :**

(*a*) *Senator C. F. W. Wickramasinghe.*—The Chairman reported that all members had agreed to the restoration of Senator Wickramasinghe to membership.

(*b*) *Changes in Membership.*—The Chairman reported that Messrs. S. Pathmanathan and Errol A. Jayawickreme had been nominated to represent the Low-Country Products Association with effect from 21st January, 1955, in place of Messrs. W. P. H. Dias and W. Herbert de Silva.

In view of the termination of Mr. Dias' period of membership it was agreed that Dr. H. E. Young, Vice-Chairman, should officiate as Chairman until the next Board meeting.

2. **Minutes :**

(*a*) *Confirmation.*—Draft minutes of the meeting held on 1st November, 1954, which had been circulated to members, were signed by the Chairman.

(*b*) *Matter arising from the minutes :*

Estate Superintendent.—A letter from Mr. G. W. D. Barnet stating that he will not accept re-engagement on the termination of his present contract in February, 1955, was read. It was agreed that the post be advertised immediately. A Committee consisting of the Chairman, the Director, Mr. H. Creighton and Mr. G. H. Carter was appointed to consider the applications and make a selection.

2. **Smallholdings Dept. ;**

(*a*) *Transfer of Office.*—It was reported that arrangements had been made to rent out No. 33, Clifford Place, Colombo 4, for use as the Smallholdings Department's Office with effect from 1st February, 1955.

(*b*) *Field Day.*—It was agreed that a Field Day be held once a year at Dartonfield for the purpose of acquainting the Rubber Instructors of the Smallholdings Department with the latest developments in rubber planting methods, etc.

(*c*) *Letter of Appreciation.*—A letter from a resident of Kadugannawa expressing appreciation of the work done by the Smallholdings Department in that area was read.

3. **Finance Committee :**

Recommendations made at meetings held on 9th November, and 10th December, 1954 :

(*a*) *Revised Draft Estimates for* 1955.—Revised estimates prepared in accordance with the recommendations of the Finance Committee were approved and it was agreed that a copy be forwarded to the Minister of Agriculture and Food for his information.

(*b*) *Salaries of New Entrants.*—A Committee consisting of the Chairman, the Director, Mr. Carter and Mr. Mahadeva was appointed to review the salary scales of the staff.

4. **Reports and Accounts :**

(*a*) *Auditor-General's Report for* 1953—was adopted.
(*b*) *Receipts and Payments Account for the 3rd Quarter* 1954—was approved.

5. **Staff :**

(*a*) *Chemist.*—The Chairman reported that Dr. E. J. Risdon, Chemist, had returned from leave and resumed duties on 11th December, 1954.

(*b*) *Agronomist.*—The Chairman reported that Mr. D. H. Constable, Agronomist, had accepted re-engagement on the terms offered at the last meeting.

(*c*) *Technical Assistant to the Director.*—The Chairman reported that Mr. O. S. Peries, B.Sc.Agr. (Melbourne) had accepted appointment on the terms offered and had assumed duties on 1st November, 1954.

(*d*) *Rail Warrants for Air Travel.*—The issue of railway warrants to the staff for air travel within Ceylon was approved.

(*e*) *Group Insurance Scheme.*—The formation of a Group Insurance Scheme for the staff and the utilisation of Provident Fund contributions for payment of premia thereto were approved subject to the rules of the Provident Fund being amended for this purpose.

6. **London Advisory Committee :**

Minutes of the meeting of the Special Committee appointed to consider transfer of the technological work to the B.R.P.R.A. held on 8-11-54—were tabled.

7. **Publications :**—The following publications were tabled :—

1. Report of the work of the Rubber Research Board in 1953.
2. First Quarterly Circular for 1954.
3. Second Quarterly Circular for 1954.
4. Advisory Circular No. 32 — Crown Budding for Oidium Resistance (Revised October, 1954).

5.	Advisory Circular	No. 37A—Manuring, Magnesium Deficiencies in Rubber.
6.	do.	No. 40—Tapping of Hevea Rubber.
7.	do.	No. 41—Pink Disease.
8.	do.	No. 42—Sale of Budwood.
9.	do.	No. 43—Oidium Leaf Disease.
10.	do.	No. 44—Diplodia Dieback and Collar Rot of Hevea and Blue Spot of Crepe Rubber.
11.	do.	No. 49—Root Disease in Replanted Areas.

A letter from the Ceylon Association in London expressing its appreciation of the valuable work done by the staff of the Institute, as recorded in its publications, was read.

8. **Next Meeting :** In view of the fact that the present Chairman's term of membership was due to terminate on 20th January, it was agreed that a special meeting of the Board be held at the Rubber Controller's Office, Colombo, at 2-30 p.m. on 2nd February, 1955, for the purpose of electing a Chairman.

9. **Rubber Research Ordinance :** It was reported that a Bill to amend Section 4 of the Ordinance to enable the Board to borrow money had been passed by Parliament.

Before the meeting terminated the Chairman mentioned that that would be his last meeting as Chairman, as his period of membership of the Board was due to terminate shortly. He thanked members for the valuable assistance they had given him during his period of office and he also thanked the staff for the good work done by them during this period.

Dartonfield,
Agalawatta.
1-2-1955.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of a Special Meeting of the Rubber Research Board held at the Rubber Controller's Office, Eastern Bank Building, Colombo, at 2-30 p.m. on Wednesday, 2nd February, 1955.

Present :—Dr. H. E. Young, Director, R.R.I.C. and Acting Chairman (in the Chair), Mr. G. H. Carter, Mr. H. Creighton, Mr. W. P. H. Dias, J.P., Mr. Errol Jayawickreme, J.P., U.M., Dr. A. W. R. Joachim (Director of Agriculture), Mr. B. Mahadeva (Rubber Controller), Mr. S. Pathmanathan, Senator C. F. W. Wickramasinghe and Mr. C. D. de Fonseka (Administrative Secretary).

An apology for absence was received from Mr. R. H. Wickramasinghe, Acting Deputy Secretary to the Treasury.

1. **Board :**

(*a*) *Membership.*—The Chairman reported that :

1. Mr. W. P. H. Dias, J.P., had been nominated by the Hon'ble the Minister of Agriculture and Food to represent smallholders with effect from 1st February, 1955.

2. Mr. R. H. Wickramasinghe had been appointed to act as Deputy Secretary to the Treasury with effect from 19th January, 1955, and had replaced Mr. W. D. Gunaratna on the Board with effect from that date.

(*b*) *Chairman.*—The Acting Chairman called for nominations for the Chairmanship which had fallen vacant on the termination of Mr. W. P. H. Dias' membership as a representative of the Low-Country Products Association on 20th January, 1955.

Mr. Jayawickreme proposed that Mr. S. Pathmanathan be elected Chairman. Mr. Carter seconded. Carried unanimously.

Mr. Pathmanathan then took the chair and thanked members for the honour they had done him by electing him Chairman. He also thanked Mr. W. P. H. Dias for his services as Chairman and Messrs. W. D. Gunaratna, W. Herbert de Silva and Gate-Muhandiram Jayasinghe for their services as members of the Board.

2. **Committees.**—Mr. W. P. H. Dias was nominated to serve on the Experimental and Smallholdings Committees in the place of Gate-Muh. Jayasinghe.

Agreed that Mr. G. H. Dulling should replace Mr. H. Creighton on the Experimental Committee and the Selection Committee for appointment of an Estate Superintendent when the former resumes membership of the Board.

3. **Conference of Smallholders.**—Consequent on a suggestion made by Mr. Dias it was agreed that regional conferences be arranged for smallholders in the various rubber planting districts.

4. **Royal Agricultural and Food Exhibition, 1956.**—Agreed that the Rubber Research Institute should participate in this exhibition jointly with the Rubber Control Department.

5. **Smallholdings Department.**—It was reported that the office of the Smallholdings Department had been moved to No. 33, Clifford Place, Colombo 4, on 1st February, 1955.

6. **Next Meeting.**—Agreed that the next meeting of the Board be held at the Rubber Controller's Office, Colombo, at 2-30 p.m. on 16th March, 1955.

Dartonfield,
Agalawatta.
16th February, 1955.

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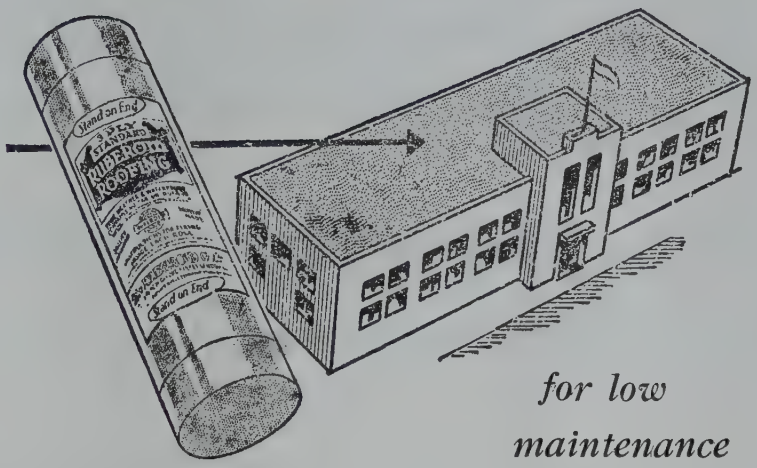

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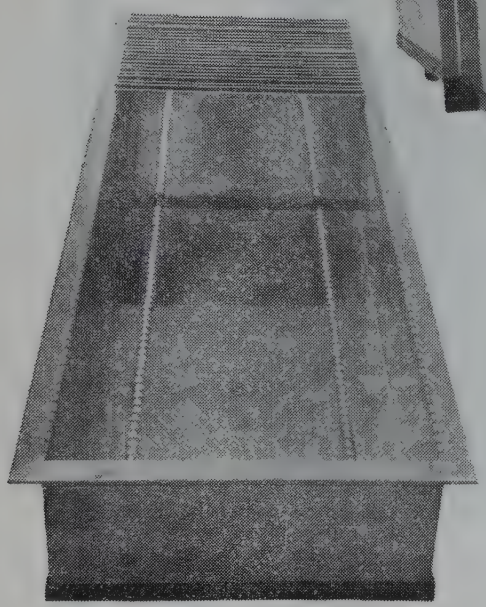

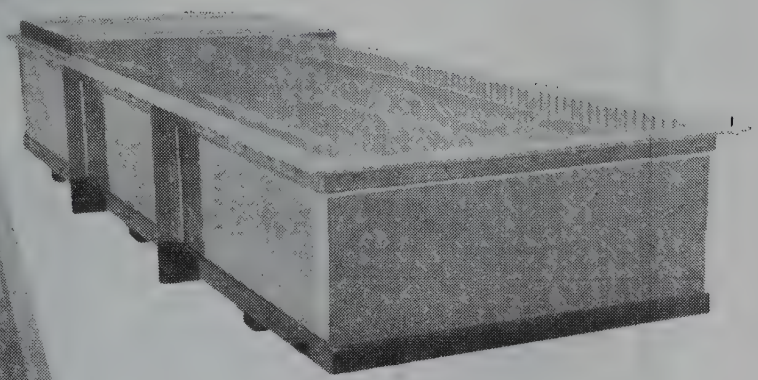

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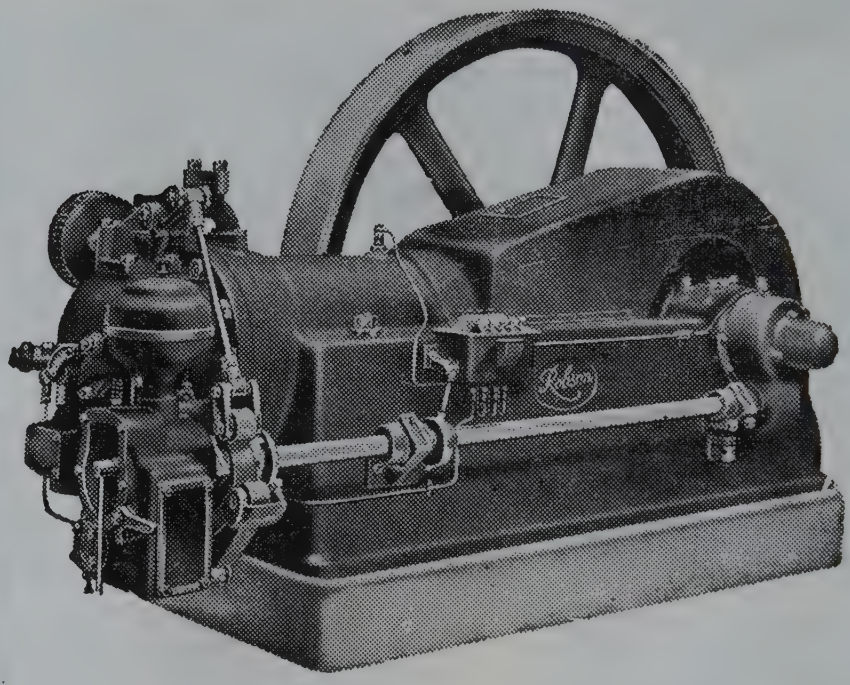

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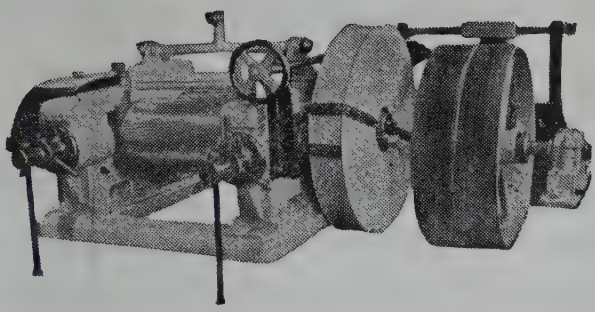

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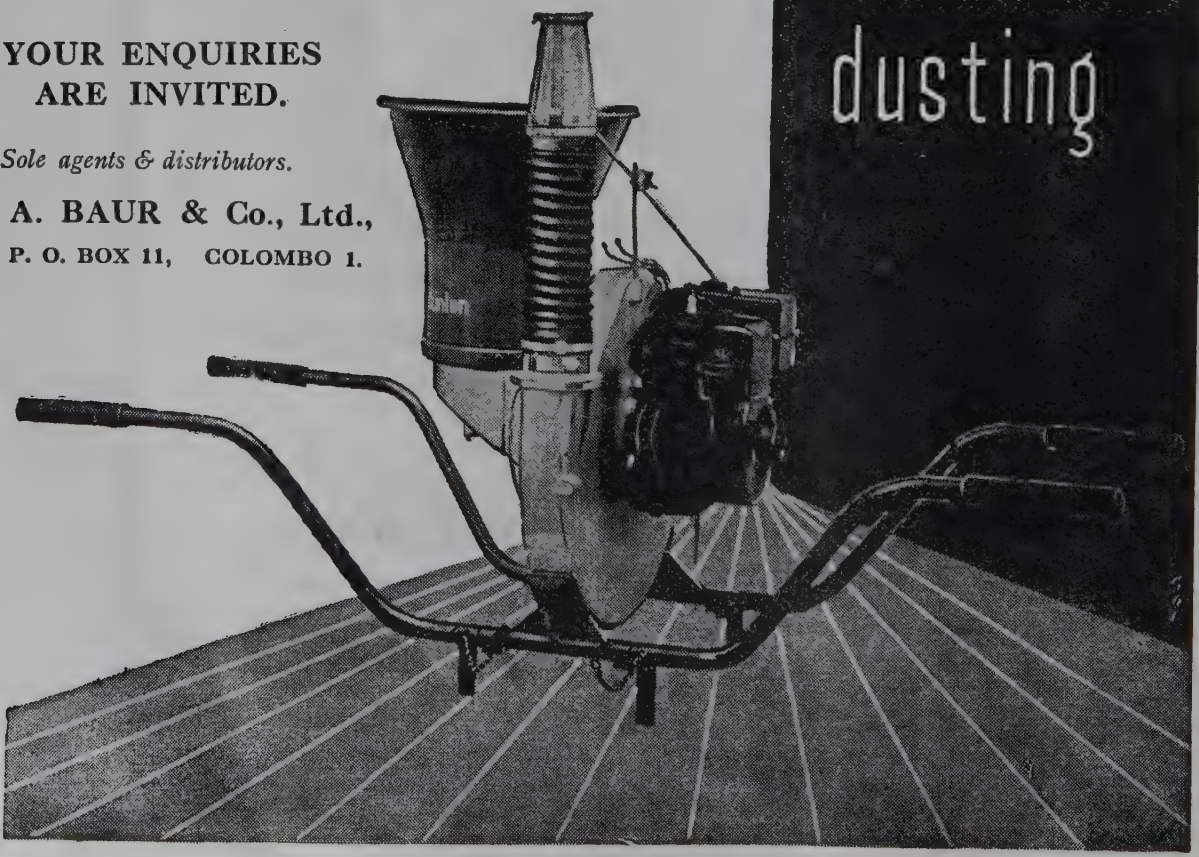

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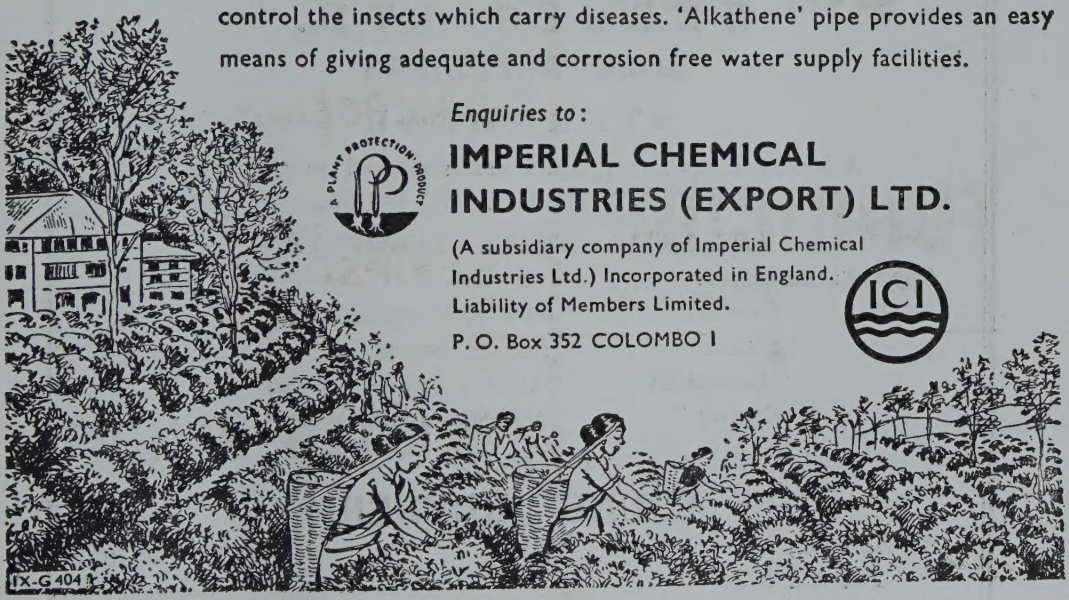

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